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DEPARTEMENT VAN
HANDEL EN NYWERHEID

Certificate
PATENT OFFICE
REPUBLIEK VAN SUID-AFRIKA

DEPARTMENT OF TRADE
AND INDUSTRY

REC'D 06 JUN 2003
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Hiermee word gesertifiseer dat
This is to certify that

the documents annexed hereto are true copies of:

Application forms P.1 and P. 2, provisional specification and drawings of South African Patent Application No. 2001/5461 as originally filed in the Republic of South Africa on 3 July 2001 and post-dated to 3 January 2002 in the name of NXCO INTERNATIONAL LIMITED for an invention entitled: "SHOCKWAVE DEFORMING MEMBER".

Geteken te / Signed at PRETORIA in die Republiek van Suid-Afrika, hierdie / in the Republic of South Africa, this 15th dag van / day of May 2003

Registrateur van Patente
Registrar of Patents

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) or (b)

FORM P2
M R & F Ref: P.19155/Case 5

REPUBLIC OF SOUTH AFRICA

PATENTS ACT, 1978

P056 - abalone

REGISTRAR OF PATENTS

Official Application No.			Lodging date: Provisional		Acceptance date:	
21	01	20015461	22	~~3 JULY 2001~~ 3-1-2002	47	
International classification			Lodging date: Complete		Granted date:	
51			23			

Full name(s) of applicant(s)/Patentee(s)	
71	NXCO INTERNATIONAL LIMITED

Applicant(s) substituted:		Date Registered:
71		

Assignee(s):		Date Registered:
71		

Full name(s) of inventor(s)	
72	To be advised

Priority claimed	Country		Number		Date	
Note:	33	NONE	31	NONE	32	NONE
Use International	33		31		32	
Abbreviation for Country	33		31		32	

Title of Invention:	
54	SHOCKWAVE DEFORMING MEMBER

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Patent of Addition No.		Date of any change:	
61			
Fresh Application based on:		Date of any change:	

McCALLUM, RADEMEYER & FREIMOND
Ref: P19155/Case 5

FORM P1
5

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

APPLICATION FOR A PATENT AND ACKNOWLEDGEMENT OF RECEIPT

(Section 30(1) - Regulation 22)

The grant of a patent is hereby requested by the undermentioned applicant on the basis of the present application filed in duplicate

REGISTRAR OF PATENTS, DESIGNS, TRADE MARKS AND COPYRIGHT
R10 R50
REGISTRATEUR VAN PATENTE, MODELLE, HANDELSMERKE EN OUTEURSREG

OFFICIAL APPLICATION NO.

21	01	20015461

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

ADDRESS(ES) OF APPLICANT(S)

Saffrey Square, Suite 205, Bank Lane, Nassau, Bahamas

TITLE OF INVENTION

54	SHOCKWAVE DEFORMING MEMBER

Priority is claimed as set out on the accompanying Form P2.
The earliest priority claimed is :

This application is a patent of addition to Patent Application No.	21	01	
This application is a fresh application in terms of section 37 and based on Application No.	21	01	

THIS APPLICATION IS ACCOMPANIED BY:

X	1	A single copy of a provisional specification of 10 pages
	2	Two copies of a complete specification of .... pages
X	3	..4 . sheets of Informal Drawings
	4	.... sheets of Formal Drawings
	5	Publication particulars and abstract (Form P8 in duplicate)
	6	A copy of Figure .... of drawings (if any) for the abstract
	7	Assignment of Invention
	8	Certified priority document(s) Number(s)
	9	Translation of priority document(s)
	10	An assignment of priority rights
	11	A copy of the Form P2 and the specification of SA Patent Application No. 21 01
	12	A declaration and power of attorney on Form P3
	13	Request for ante-dating on Form P4
	14	Request for classification on Form P9
X	15	Form P2 in duplicate

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Dated this 3rd day of July 2001.

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PATENT AGENTS FOR APPLICANT(S)

REGISTRAR OF THE COURT OF THE COMMISSIONER OF PATENTS
3.1.2002 Post-dated
~~2001-07-03~~
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P.19155/Case 5

FORM P6

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978

PROVISIONAL SPECIFICATION

(Section 30(1) – Regulation 27)

OFFICIAL APPLICATION NO

21	01	20015461

LODGING DATE

Post-dated

22	3-1-2002. 3 ~~JULY 2001~~

FULL NAME(S) OF APPLICANT(S)

71	NXCO INTERNATIONAL LIMITED

FULL NAME(S) OF INVENTOR(S)

72	To be advised

TITLE OF INVENTION

54	SHOCKWAVE DEFORMING MEMBER

BACKGROUND OF THE INVENTION

This invention is concerned generally with a customized low energy method of breaking rock in a controlled manner.

As used herein the word "rock" includes rock, ore, coal, concrete and any similar hard mass, whether above or underground which is difficult to break or fracture. It is to be understood that "rock" is to be interpreted broadly.

A number of techniques have been developed for the breaking of rock using non-explosive means. These include a carbon dioxide gas pressurisation method (referred to as the Cardox method), the use of gas injectors (the Sunburst technique), hydrofracturing and various methods by which cartridges containing energetic substances pressurise the walls or base of a sealed drill hole to produce penetrating cone fractures (known as PCF).

These techniques may be an order of magnitude more efficient than conventional blasting in that they require approximately 1/10 of the energy to break a given amount of rock compared to conventional blasting using high explosives. The lower energy reduces the resulting quantity of fly rock and air blast and to an extent allows the rockbreaking operation to proceed on a continuous basis as opposed to the batch-type situation, which prevails with conventional blasting.

Low energy rockbreaking methods, such as those using propellants, generally use high gas pressures to propagate fractures originating from microfractures

and points of weakness in the rock such as joints, fissures and faults. Depending on rock conditions and mining requirements such as breaking rock to a particular size, it may be desirable to induce a region of high stress concentration at any chosen location, at the bottom or otherwise, in the drill hole, to initiate new fractures in the rock. An object of the present invention is to achieve such a result.

SUMMARY OF INVENTION

The invention provides a low energy method of breaking rock which includes the steps of:

(a) generating at least one shock wave inside a hole in the rock, and

(b) deforming the shock wave to create at least one region inside the hole which has an increased stress concentration.

At the said region the energy density of the wave may be greater than elsewhere in the hole. This creates a stress point in the rock at or adjacent the region.

The method may include the steps of loading a cartridge into the hole and initiating a propellant in the cartridge to generate the shock wave.

The shock wave may be deformed in any appropriate way, using any suitable technique. Without being limiting the shock wave may be deformed by at least one of the following: by shaping the cartridge at one or more regions to induce shock wave deformation; by inserting or forming one or more wave

deforming members on an inner or outer side of the cartridge; by locating one or more wave deforming members inside the cartridge.

In one form of the invention the shock wave is deformed by suitably shaping a base or a side wall of the cartridge.

The invention also provides apparatus for breaking rock which includes a cartridge, a propellant inside the cartridge, and at least one shock wave deforming member which is exposed to a shock wave generated by initiating the propellant.

The cartridge may include a base and a side wall which extends from the base, the base and the side wall forming an enclosure for the propellant.

The cartridge may include a device for initiating the propellant.

The shock wave deforming member may be selected from at least one of the following: at least one formation on or near the base; at least one formation on an inner or outer surface of the side wall; at least one suitably shaped member inside the cartridge, or outside the cartridge; at least one suitably shaped member inside the propellant positioned at a desired distance relatively to the base.

As used herein "propellant" is to be interpreted broadly to include a propellant, blasting agent, gas-evolving substance, explosive or similar means which, once initiated, generates high pressure jet material typically at least partly in

gaseous form. Propellants of this type are known in the art. In this specification the words "propellant" and "blasting agent" are used interchangeably.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described by way of examples with reference to the accompanying drawings Figures 1 to 7 which respectively illustrate from the side and in cross section different forms of apparatus for breaking rock according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 of the accompanying drawings illustrates a hole 10 which is drilled into a rock mass 12 from a face 14 using conventional drilling equipment, not shown. The hole is drilled to a length L which is of the order of at least four times the diameter D of the hole.

A cartridge 16 is loaded into the hole. The cartridge has a base 18 and a cylindrical side wall 20 which extends upwardly from the base and which, at an end which is remote from the base, has a rounded shape 22.

The base and the wall 20 form an enclosure for a propellant 24 of any appropriate composition. The propellant is compressed into the cartridge under factory conditions using techniques which are known in the art. An initiator 26 is loaded into the cartridge. The initiator is located at the rounded

upper end 22 but this is by no means limiting and the initiator can be loaded into the cartridge at any appropriate point.

Control wires 28 lead from the initiator to a unit, not shown, which is used in a known manner for initiating the blasting process.

Stemming 30 is placed into the hole 10 from the rock face 14 covering the cartridge to a desired extent. The stemming is tamped or otherwise secured in position. The nature of the stemming and its manner of use are known in the art and for this reason are not further described herein.

The cartridge is of a diameter which is slightly less than the nominal diameter D of the hole. It should be possible to place the cartridge into the hole without the cartridge becoming frictionally jammed against the wall 34 of the hole. On the other hand it is desirable for the cartridge to fit fairly intimately into the hole so that an annular clearance gap between the cartridge and the wall 34 is relatively small.

At least the wall 20 is made from a malleable material which is capable of plastic deformation without rupture at least to a predetermined extent.

The base 18 is formed with a central socket-like region 36 which directly opposes a bottom 38 of the hole. The region 36 is flanked by a sloping or conical-like formation 40 which extends downwardly towards a lower extremity of the wall 20.

Ignition of the propellant 24 by the initiator 26 causes the release of high pressure jet material which is substantially in gaseous form. The cartridge 16 is designed to contain the expanding high pressure jet material and is allowed to deform outwardly, without rupturing, so that the wall 20 of the cartridge is forced into sealing contact with an opposing surface of the wall 34 of the hole. The cartridge does not fracture during this process for it is fabricated from a plastically deformable material.

At an upper end the cartridge is contained by the stemming 30.

The high pressure jet material released by ignition of the propellant gives rise to a shock wave which propagates in the cartridge downwardly as the propellant ignites. The shock wave strikes the base 18 and the conical formation 40 directs the shock wave, which impinges on the formation, radially outwardly towards the periphery of the base. The shock wave is thus deformed and a high energy density region of the shock wave is produced at lower peripheral extremities of the base more or less at the junction of the bottom 38 of the hole with the side wall 34. This causes fracturing of adjacent regions of the rock.

It is possible to deform the shock wave generated by the ignited propellant in a variety of ways. The invention is not restricted in this regard. In Figure 1 a base of the cartridge is shaped to produce the desired way of deformation. As a consequence rock fracture is initiated at the bottom of the hole.

Figure 2 illustrates an alternative technique wherein a cartridge 16 is placed in a hole 10 and covered with stemming 30. There are strong similarities between the arrangement shown in Figure 2 and that shown in Figure 1 and for this reason components which are the same in the two embodiments bear like reference numerals. It is to be noted however that in the Figure 2 embodiment of the invention the base 18 is planar and, to a substantial extent, rests on the bottom 38 of the hole. Thus the base is not used, in itself, to deform the shock wave inside the cartridge.

Two rings 40 and 42 are positioned inside the cartridge and are secured to the inner surface of the wall 20 by means of a suitable adhesive. This step is taken before the propellant 24 is placed inside the cartridge.

When the propellant is ignited a shock wave is transmitted through the combusting charge. Discontinuities are created by the rings 40 and 42 which present localised barriers to propagation of the wave. Although the resulting effect on the shock wave is complex high energy regions of the shock wave are generated in the vicinity of each ring. It is believed that the deformation of the shock wave gives rise to interference between two or more shock wave fronts and this in turn gives rise to an increase in the energy density. Another factor is that the shock wave passes through a region of a first set of properties, ie. those of the combusting propellant, into a region with a second set of properties, ie. those arising from the material of each ring. This causes diffraction effects and, again, the shock wave is deformed. The applicant has established through experimentation that by choosing the size and position of

the rings correctly the rock can be caused to fracture at regions other than the bottom of the hole.

In the arrangement shown in Figure 3 a discontinuity is created inside the interior of the cartridge by forming the side wall 20 with an internally extending circumferential channel or recess 44. The channel 44 has an effect similar to that of the ring 40 in that a localised high stress region is produced by deforming the propagating shock wave which is generated by combustion of the propellant 24.

Figure 4 illustrates a cartridge 16 which has a ring 46 at a desired location on an outer surface of the side wall 20. When the propellant 24 is ignited the wall 20 is forced radially outwardly into close sealing contact with the wall 34 of the hole. The ring 46 is however not compressible to any significant extent and consequently forms an inwardly extending peripheral rib or ridge which acts in a manner which is similar to that of the ring 40 in Figure 2. Once again the shock wave is deformed and a localised high energy region is produced which gives rise to fracture of the rock at a region which is close to the ring 46.

Figure 5 shows a cartridge 16 with external ribs 48 and 50 respectively which are integrally formed with the side wall at selected locations. The ribs 48 and 50 function in the same way as the ring 46 shown in Figure 4 in that they deform the shock wave and produce high energy stress regions which promote localised cracking or fracture of the opposing rock surface.

Figures 6 and 7 illustrate that it is possible to deform the shock wave inside the cartridge by using members which are not at a periphery of the cartridge. In the Figure 6 arrangement a cartridge 16 with a regular side wall 20 and a planar base 18 is positioned in a hole 10. A solid insert 60 is positioned inside the propellant 24. The insert is supported on a stalk 62 which extends upwardly from the base 18. The size of the insert 60 may vary according to the degree of shock wave deformation which is required. Although the resulting situation is complex and at least to some extent the size and position of the insert may be required to be determined empirically it is possible to produce localised high stress regions in order to promote rock fracture at one or more predetermined locations.

The arrangement shown in Figure 7 is similar to that shown in Figure 6 in that an insert 64 is effectively imbedded in and surrounded by the propellant 24. In this instance however the insert is supported on small arms 66 which extend from an inner surface of the side wall 20.

It is to be noted that the cartridge confines the expanding high pressure jet material which is released by the ignited propellant in such a way that the cartridge is expanded and is thereby forced into contact with the surrounding wall of the rock. As the shock wave propagates through the cartridge interior the shock wave deforming member or members, which can take on a variety of forms, produce localised high energy regions which promote rock fracture at predetermined points in the rock mass.

Dated this 3rd day of July 2001.

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Patent Agents for the Applicant

20015461

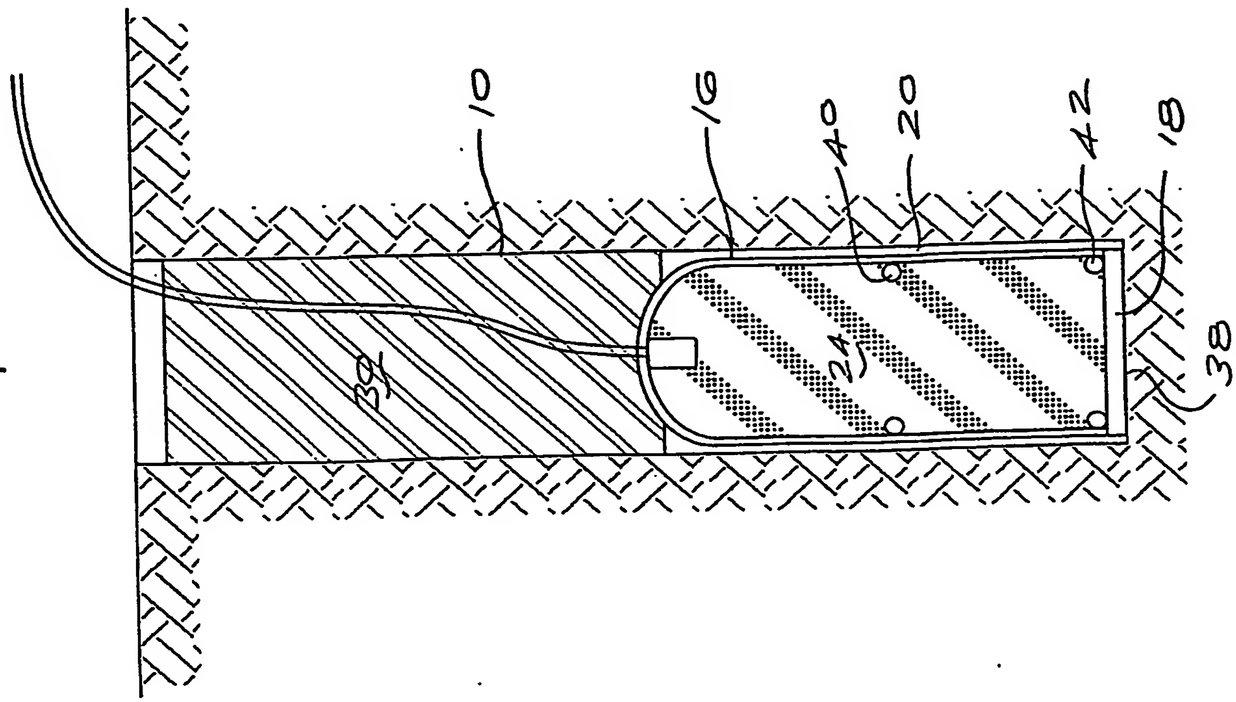

FIG 2

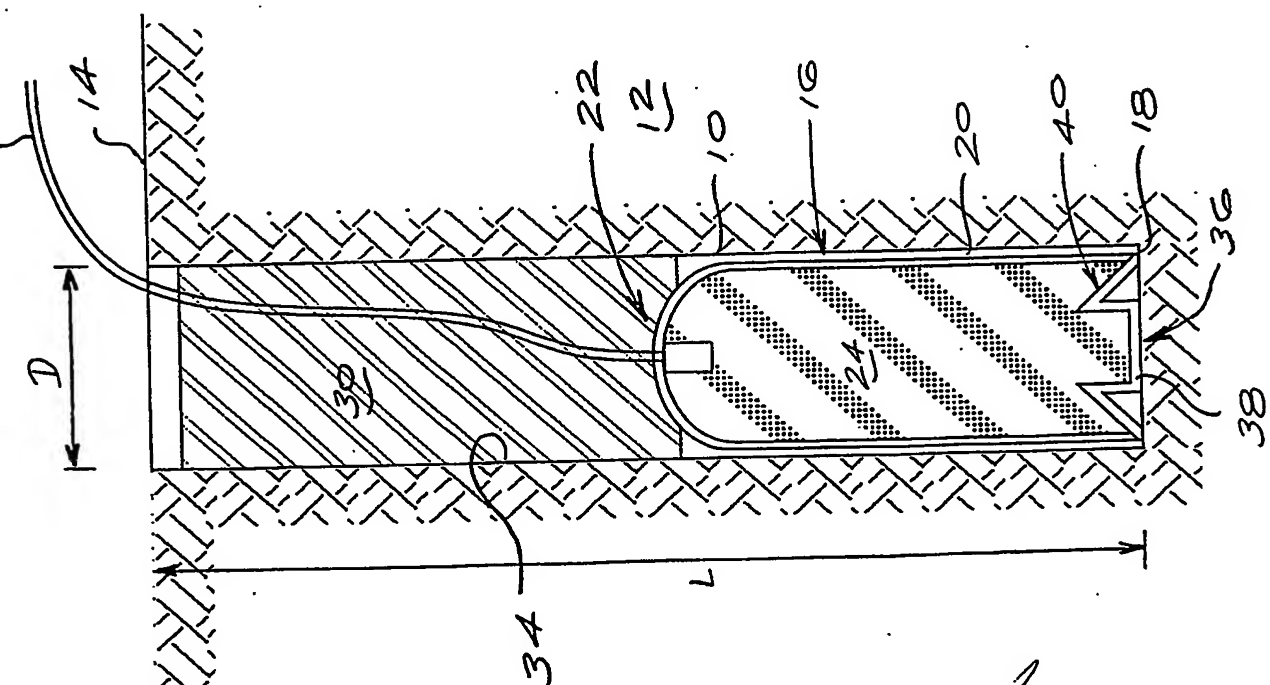

FIG 1

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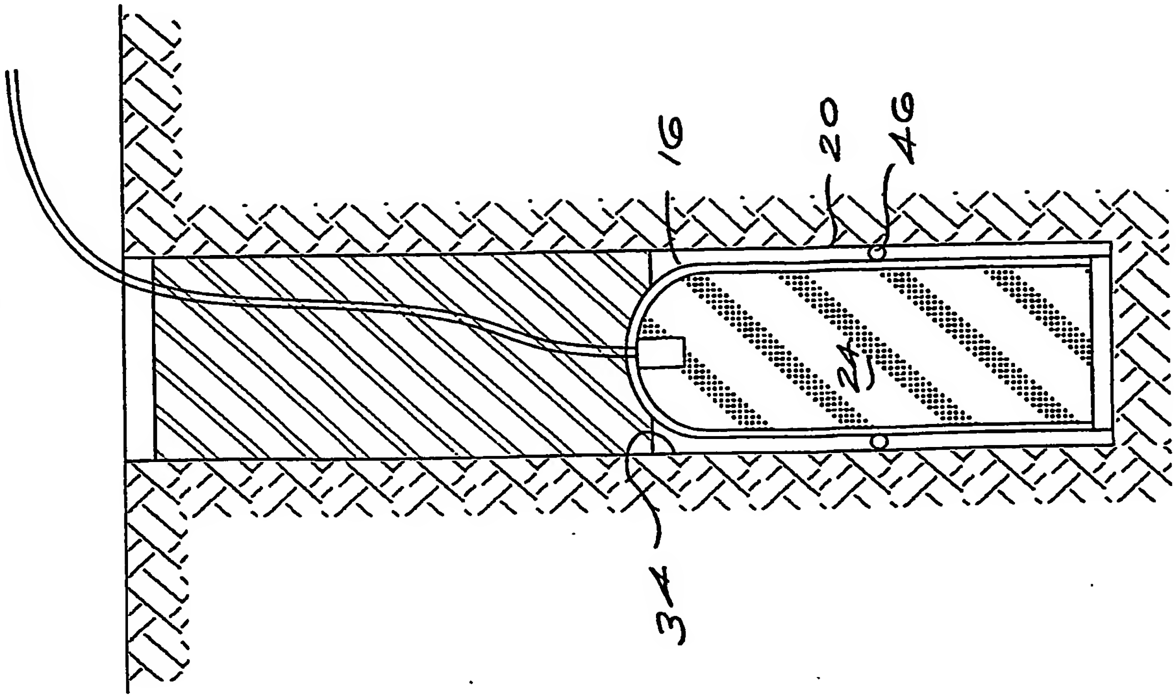

FIG 4

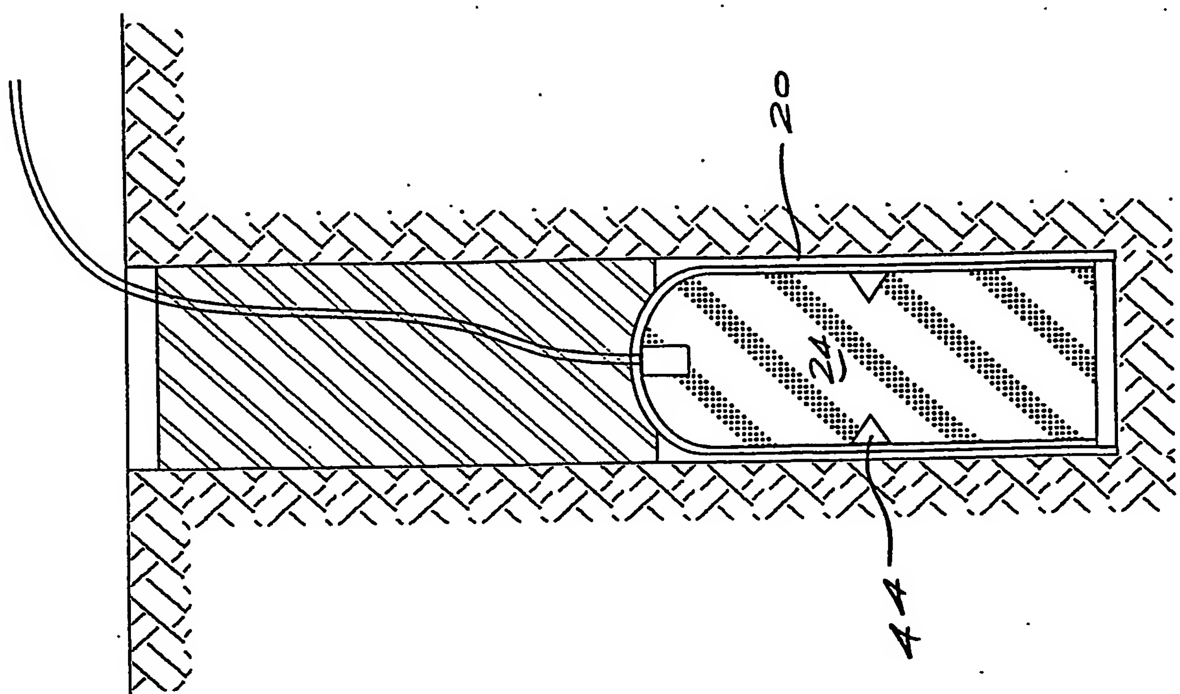

FIG 3

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FIG 5

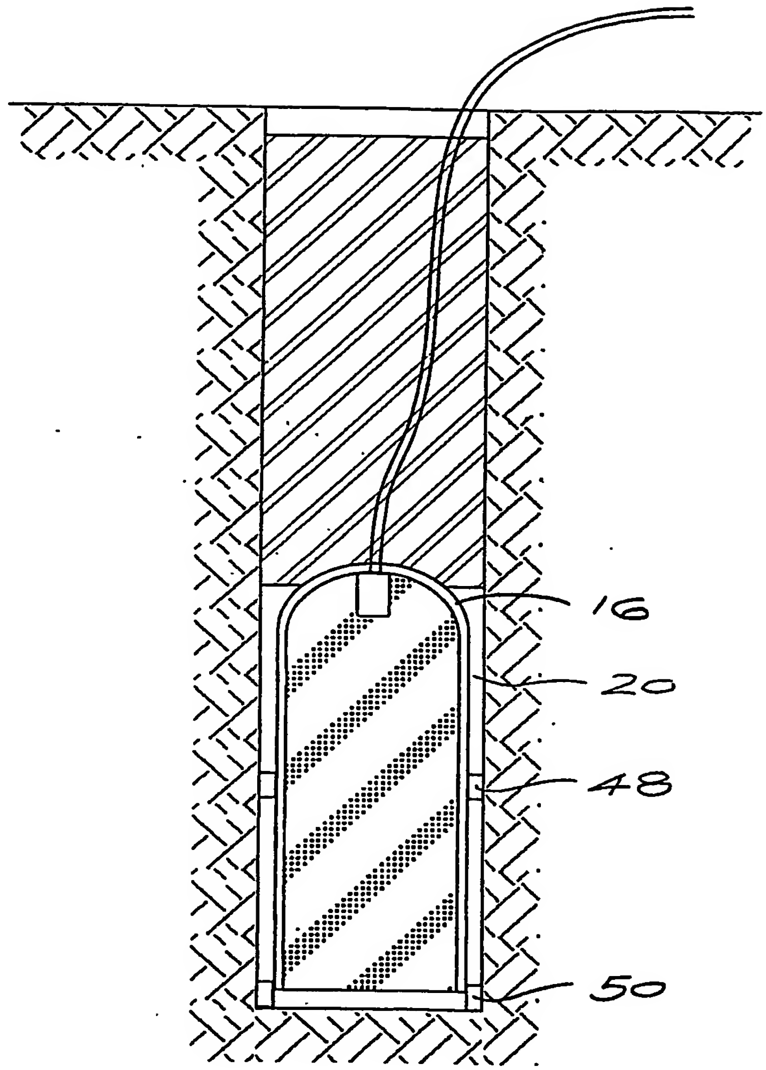

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FIG 7

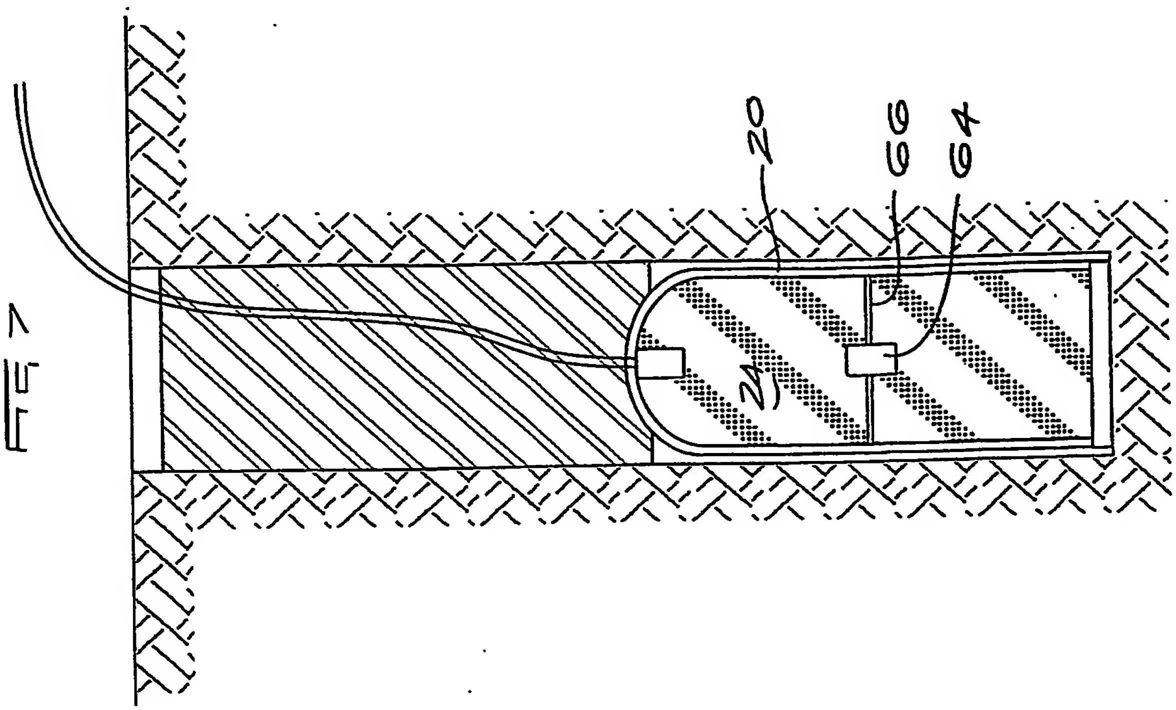
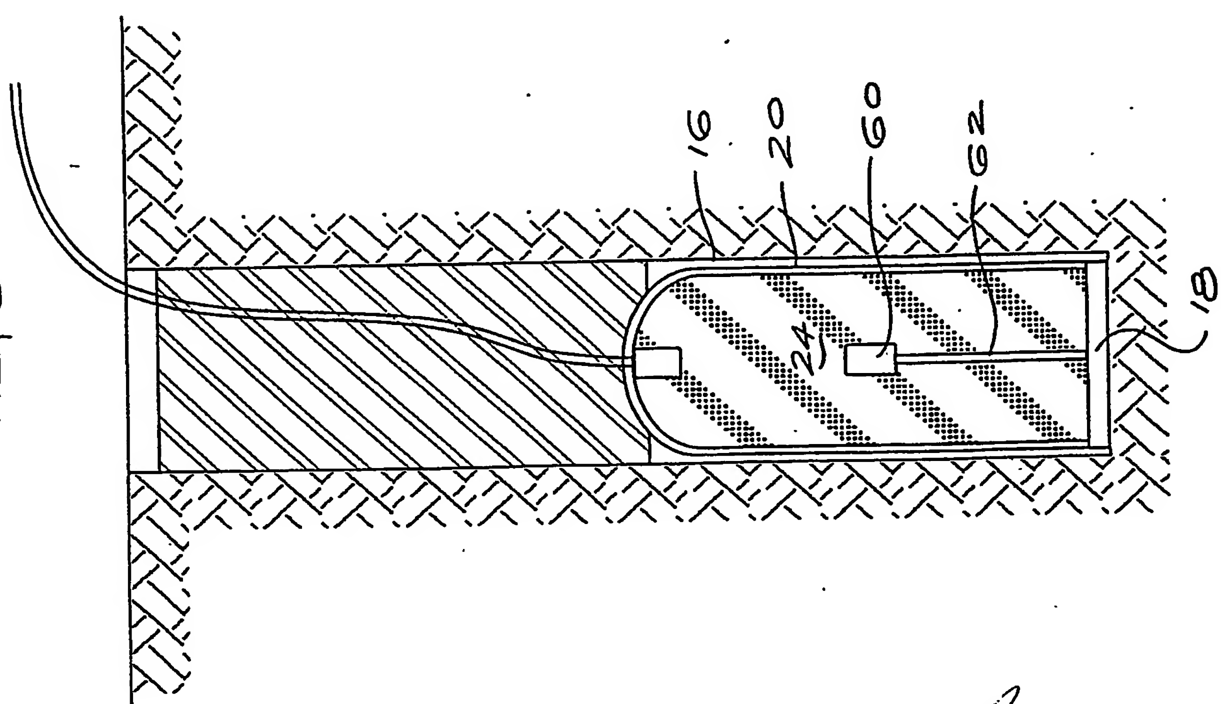


FIG 6



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